2nd edition

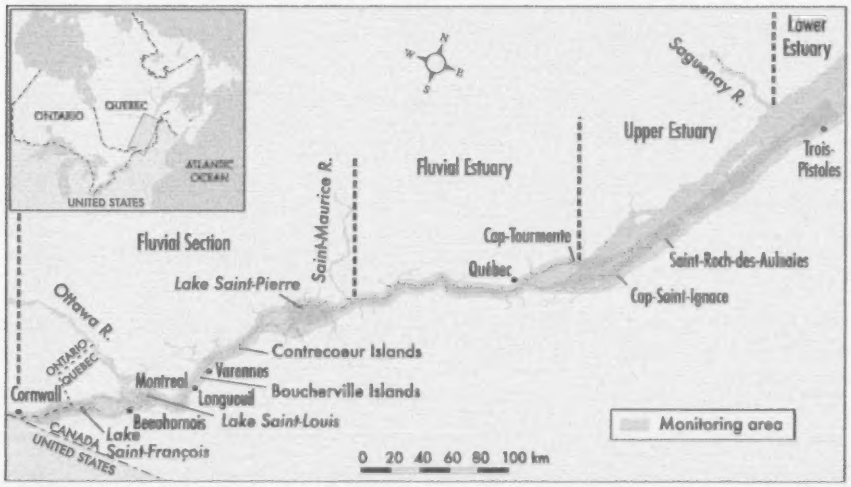
FRESHWATER WETLANDS AND EXOTIC PLANT SPECIES

Photo: Martin Jean, Environment Canada

Background

Wetlands encompass those areas that are saturated with water or flooded for a sufficiently long period to influence soil and vegetation, insofar as they are present. In addition to peatlands, these ecosystems comprise aquatic vegetation (permanently flooded), marshes (dominated by herbaceous plants) and swamps (dominated by shrubs or trees). Wetlands are a valuable monitoring element for reporting on the state of the St. Lawrence environment because of their important contribution to biological diversity and productivity, their purifying capacity and their role in the life cycles of a number of different plant and animal species.

Figure 1. Wetland monitoring area



Vast expanses of wetlands have disappeared over the last 400 years. Scientists estimate that close to 80% of the wetlands present in the Montreal area during the time of Jacques Cartier are gone today. Due to a lack of detailed information, however, we are unable to be more specific about wetland distribution at that time. More recently (1945–1976), 3649 hectares (ha) of wetlands were lost between Cornwall, Ontario, and Matane, Quebec, mostly before the 1960s.

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These losses can be traced directly to wetland drainage and conversion to farmland, residential and commercial development, the construction of roads and hydroelectric generating stations, and development of the St. Lawrence Seaway.

Major conservation efforts have been devoted to reducing wetland losses over the past several years. Although these initiatives are vital to ensuring the existence of natural St. Lawrence ecosystems for future generations, they do not guarantee that wetland areas and species composition will remain unchanged. A body of water is by definition an essentially dynamic element of the landscape, one that changes as a function of age, the type of substrate over which it flows, climatic and hydrologic variations, and use. Moreover, anticipated climatic changes could disrupt weather patterns and modify the water cycle, altering the pace at which wetlands are transformed.

In the St. Lawrence, wetlands are primarily concentrated in the freshwater fluvial section (Figure 1). Due to their diverse characteristics, the dynamics of these riparian wetlands were analysed on a sector-by-sector basis. To this end, maps that were actually prepared for a study of migratory bird habitats in the late 1970s were examined, along with airborne images taken by remote sensor in 1990, 1991, 1996, 1997, 2000, and by satellite in 2002, and categorized by main wetland type. The basic information was complemented by field survey data. From the fluvial section down to the gulf, St. Lawrence wetlands cover a total area of roughly 80 000 ha. The remote sensing images cover close to 29 000 ha of wetlands between Cornwall and Trois-Pistoles, excluding the largest aquatic plant communities (Table 1).

Table 1. Results of analyses of changes in wetland areas between 1990–91 and 2000–2002

Study area	Surface area (ha)			
	1990–91	2000–2002	Difference	Percentage
Lake Saint-François	2 043	2 043	0	0
Beauharnois–Valleyfield	96	102	6	6.2
Lake Saint-Louis	643	685	42	6.5
La Prairie Basins	0	2	2	–
Montreal–Longueuil	322	267	- 55	- 17.1
Varennes–Contrecœur	860	934	74	8.6
Lake Saint-Pierre	16 180	16 098	- 82	- 0.5
Fluvial Estuary	2 552	2 999	447	17.4
Quebec City–Lévis	951	951	0	0
Upper Estuary	3 123	3 279	156	4.7
Lower Estuary*	1 458	1 632	174	11.9
Total	**28 228**	**28 992**	**764**	**2.7**

*Partial coverage.

The human influence on the St. Lawrence has not been limited to reducing the area occupied by wetlands. Expanded continent-wide trade, for one, has done nothing to slow the influx of exotic and invasive species to wetland areas. The more opportunistic among them take advantage of disturbances to settle in and become, in some cases, particularly abundant.

Overview of the Situation

Since the last wetlands fact sheet was produced, new IKONOS satellite images obtained in 2002 enabled us to undertake and complete the year 2000 mapping of certain areas of interest. New field surveys conducted in summer 2003 were added to those of 2000–2001 to refine the resulting maps. We analysed this new information and have concluded that the earlier snapshot portrait we took of St. Lawrence wetlands differs slightly from the one we present today.

We observe a slight overall increase in the areal extent of marshes and swamps (wetlands excluding aquatic plant communities) between 1990–91 and 2000–2002 (Table 1). These wetlands occupied 28 228 ha in 1990–91 but 28 992 ha in 2000–2002, an increase of 764 ha or 2.7%. The results are not the same throughout the river. Wetlands were lost in the Montreal–Longueuil area and in Lake Saint-Pierre. On the other hand, major gains are recorded in the fluvial estuary, the upper estuary and a portion of the lower estuary.

In portraying the situation of St. Lawrence wetlands, multiple analyses of the changes were necessary. Earlier analyses examined Priority Intervention Zone (better known as ZIP) areas for the period 1990–91 to 2000–2002. These were supplemented,

Photo: Martin Jean, Environment Canada

data permitting, by analyses of smaller areas for the period from 1976 to 2002. All the different types of changes observed were evaluated to eliminate inconsistencies due to inherent map errors.

The complex nature of the temporal dynamics of St. Lawrence wetlands will be illustrated by means of three examples. The first will describe wetland losses occurring in Lake Saint-Pierre. The fluvial estuary will be an example of gains in wetland areas. Lastly, the area of Boucherville–Varennes will serve to illustrate changes in areal extent and species composition.

Lake Saint-Pierre

Trends point to complex transformations in the wetlands of the Berthier–Sorel archipelago. By total surface area, wetlands here decreased by 82 ha (or 0.5%) from 16 180 ha in 1990–91 to 16 098 ha in 2000–2002. Though the figure is low, we should remember that this area is vital to the biodiversity of the St. Lawrence River and that it has been recognized as a World Biosphere Reserve. The map of wetland losses and gains (Figure 2) illustrates the spatial distribution of the main changes observed from 1990–91 to 2000–2002. Gains are shown in green, while losses are depicted in tones of red (from pink to dark red). Wetlands here gave up 1046 ha to open-water zones, which are scattered all around the lake, Baie Saint-Francois, other islands in the Lake Saint-Pierre archipelago, as well as an especially large number in Baie du Febvre (see Figure 2). Some of these changes may have been caused by structures built to keep local water levels high. Also at issue is the conversion of 789 ha of wetlands for agriculture (crops and pastureland) and the transformation of 114 ha into bare soil, especially at the eastern tip of Ile Dupas. On the other hand, 1869 hectares of new wetlands emerged from the open-water zone during this same period. Scattered around many Lake Saint-Pierre islands and also on the north and south shores of the lake, they are seemingly the result of lower water levels. Other major modifications were observed during the same period (Figure 3). The most remarkable of these is undoubtedly the transformation of 1064 ha of low marshes into high marshes dominated by *Phalaris arundinacea* (Reed Canarygrass) (790 ha) and *Phragmites australis* (Common Reed) (9 ha), both invasive plants damaging to plant diversity. Using the wetland map of 2002, we were able to estimate the extent of dense populations of *P. arundinacea* and *P. australis* for the first time. Thus, high marshes dominated by *P. australis* total 18 ha and are

Figure 2. Wetlands gained and lost in Lake Saint-Pierre between 1990–91 and 2000–2002

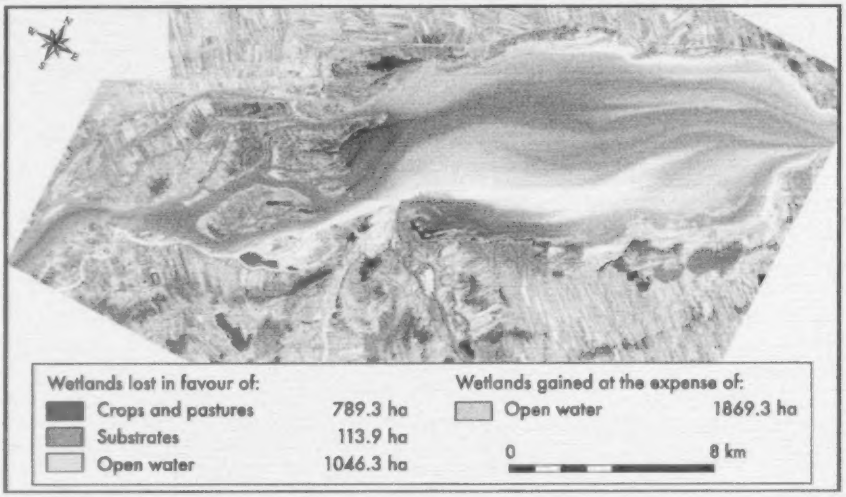
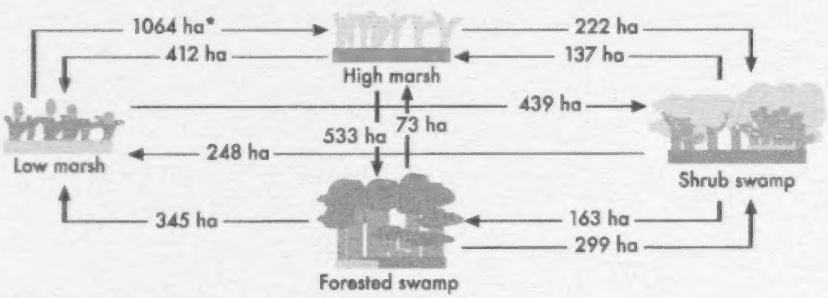


Figure 3. Changes in Lake Saint-Pierre wetlands between 1990–91 and 2000–2002



Phalaris: 790 ha; Phragmites: 9 ha; Others: 265 ha.

concentrated in the Baie de Lavalliere. Field checks indicate, however, that this species is present elsewhere in the Lake Saint-Pierre area. P. *arundinacea*, for its part, dominates over 3152 ha of high marsh and may occupy an even larger space if we include dry meadow, where this species occurs and is dominant.

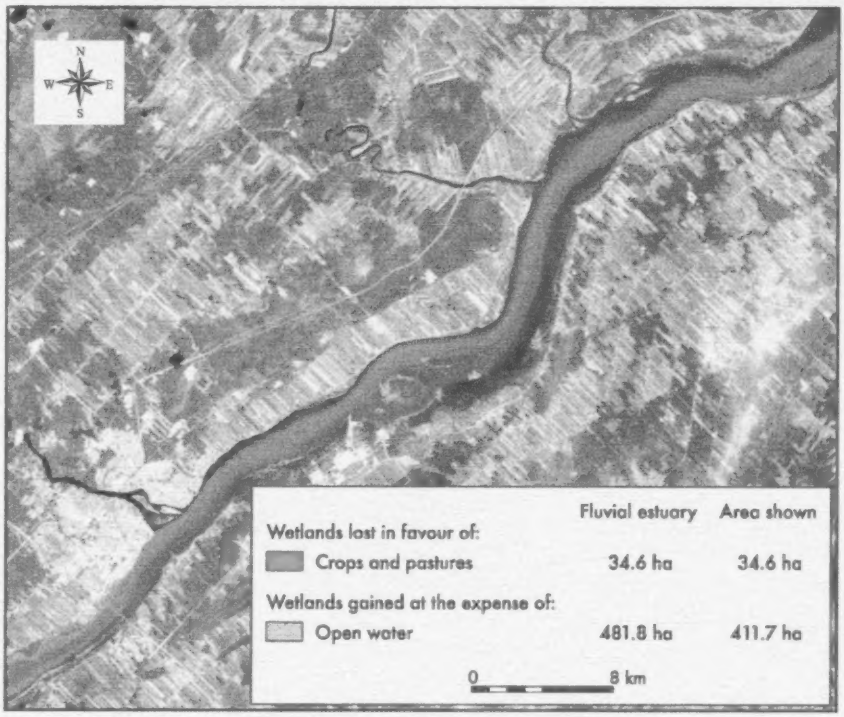
Fluvial Estuary

Some open-water zones in the fluvial estuary have given way to wetlands, which grew in size from 2552 ha in 1990–91 to 2999 ha in 2000–2002, or 447 ha (18%) (Figure 4). These wetlands can be seen along most of the south shore of the St. Lawrence, particularly in Becancour and on the Gentilly and Saint-Pierre mudflats. These changes are due to the different, expanded configuration of low marshes and to the presence of low marshes flooded by tides in 2000–2002. It was also noted that some low marshes in the Gentilly region, present in 1990–91, have since become forested swamp. An examination of raw images of the site appears to confirm this transformation, which may have been caused by localized sediment deposition. No plant communities dominated by invasive plants were detected in this sector.

Boucherville and Varennes Islands

Wetlands on the islands of Boucherville and Varennes have undergone many changes over the past 25 years, both in terms of the space they occupy and their species composition. The period from 1976 to 1990–91 was marked by a 14% loss in wetland area in favour of bare soil, fallow land and forest. These changes are particularly obvious on Île Charron and along the canals in the Boucherville Islands (Figure 5). During the period from 1990–91 to 1996–97, a comparable rate of loss of 11% was observed, this time in favour of open water. Variations in water levels appear to be to blame. Lastly, during the period from 1996–97 to 2000–2002, a net gain of some 10% in wetland area was noted, the result of wetlands around the Boucherville Islands expanding into open-water zones. Wetland losses are nonetheless observed during this period, including 15 ha that disappeared in favour of crops and pastureland, mainly in the Iles de Varennes sector. The general trend in species composition is for low marshes to give way to high marshes, an important shift in the dynamics of this ecosystem. In other findings, the massive expansion of invasive exotic plants, especially P. *australis* but also P. *arundinacea* was noted. In the study area P. *australis* occupied 48 ha of high marsh in 2000–2002, while P. *arundinacea* covered 126 ha (202 ha including dry meadow dominated by this same species).

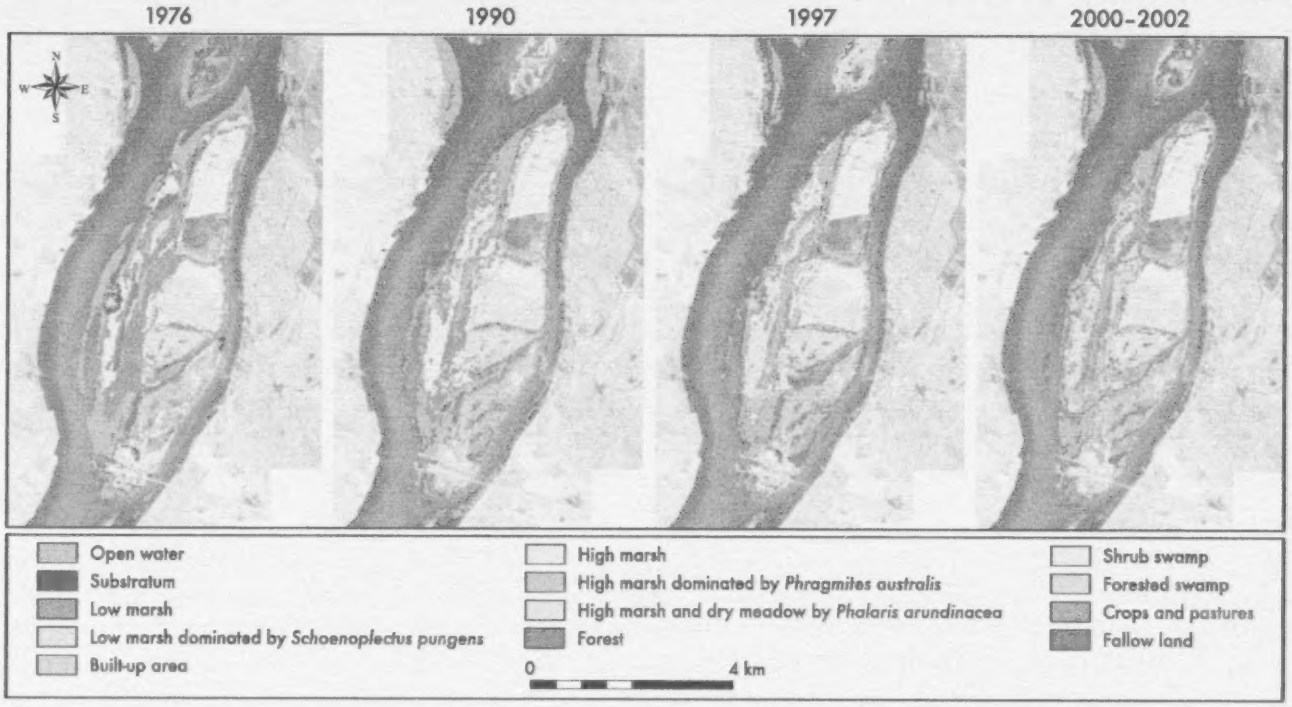
Figure 4. Wetlands gained and lost in the fluvial estuary between 1990–91 and 2000–2002



Exotic and Invasive Species

The islands of Boucherville and Varennes are good examples of the new challenges of managing and conserving St. Lawrence wetlands. The fairly dry conditions in some low marshes due to dredging in Montreal's harbour likely facilitated the spread

Figure 5. Boucherville Islands wetlands between 1976 and 2000–2002



of P. *australis*. Absent from area plant surveys in the late 1970s, this invasive species occupied almost 13% of wetlands in the Boucherville–Varennes sector in 2000–2002 and continues to progress apace.

Following decades of encroachment on the entire St. Lawrence system for agricultural, urban and industrial uses — human development remains a threat, some wetlands only having been lost during the last 25 years — the plant species composition of the remaining wetlands is being transformed. Such pressures offer a major opening for invasive non-native species to become established. Scientists agree that the biological invasion of exotic plants is one of the world's biggest ecological problems, second only to the destruction of natural habitats as the leading cause of the loss of biodiversity, and almost always irreversible.

A survey of wetland plant species in 2000 and 2001 produced a snapshot of the distribution and areal extent of invasive species along the St. Lawrence. Of the total 285 species of vascular plants observed, 37 are considered exotic species. Exotic species therefore represent 13% of the wetland flora of the St. Lawrence.

Invasions of exotic plants are particularly heavy in the fluvial section between Lake Saint-Louis and Lake Saint-Pierre, inclusively. In Lake Saint-Louis, for example, 44% of the plant cover is taken up by exotic species, whereas such species represent only 15% of the flora in the Lake Saint-Pierre wetlands (Table 2).

Exotic species have taken over more than half of the wetland habitats on many islands, including the Îles de la Paix (Lake Saint-Louis), the Tailhandier Flats (Boucherville Islands) and the islands between Varennes and Contrecoeur. Downstream of Lake Saint-Pierre, exotic species are equally, if not more numerous, but their impact is not as great (6 to 10% cover), except locally at Cap-Tourmente (18%), Cap-Saint-Ignace (19%), Saint-Roch-des-Aulnaies (27%), and Trois-Pistoles (17%). In general, sites that remain exposed for the greater part of the growing season (mostly high marshes) are invaded much more

Table 2. Distribution and coverage of exotic plants along the St. Lawrence

Study area	Number of indigenous species	Number of exotic species	Percentage of exotic species	Percentage of cover occupied by exotic species
Lake Saint-François	88	9	9.3	17.8
Lake Saint-Louis	59	11	15.7	43.6
Boucherville	86	17	16.5	41.7
Contrecœur	25	8	24.2	44.3
Lake Saint-Pierre	99	17	14.7	27.1
Fluvial Estuary	95	18	15.9	6.2
Upper Estuary	87	19	17.9	10.0

frequently by exotic species (11 to 65% cover) than are flooded sites such as submerged aquatic vegetation and low marshes (1 to 34% cover).

Only a few of the exotic species established along the St. Lawrence are invasive in nature. The exotic plants found in largest number in St. Lawrence marshlands are *Butomus umbellatus* (Flowering Rush) and *Lythrum salicaria* (Purple Loosestrife). More locally, *Hydrocharis morsus-ranae* (Common Frog-bit) and *Myriophyllum spicatum* (Eurasian Watermilfoil) are abundant in Lake Saint-François. Moreover, some species have both indigenous and exotic genotypes. The latter is most often invasive and propagates very aggressively. This could be the case for *Phalaris arundinacea*, which dominates at a number of high marshes. The story is the same for *Phragmites australis*. In 2005, *P. australis* leaves were sampled from several different plant communities extending from Lake Saint-Francois to Lake Saint-Pierre for genetic analysis, in cooperation with a team of research scientists from Laval University (B. Lelong, C. Lavoie and F. Belzile, unpub. data). The findings show that *P. australis* communities in the St. Lawrence River are mostly exotic, with a few small-scale exceptions in lakes Saint-Francois, Saint-Louis and Saint-Pierre. The impact of these plants is not uniform, however. For example, *P. australis* is relatively rare in the St. Lawrence wetlands. At 71% of sites where it is found, however, it takes up more than 50% of the invaded cover. By contrast, *Lythrum salicaria* is clearly the most widespread exotic plant in riparian wetlands, yet it covers more than 50% of the area at only 9% of sites where it occurs.

With the goal of better determining the scope and the coverage of invasive plants in St. Lawrence wetlands, local communities were invited to take part in setting up a monitoring network. The Lake Saint-Pierre sector has been identified as a priority area for this pilot project. Sightings of invasive plants have been compiled since summer 2004 by the Societe d'amenagement de la Baie de Lavalliere (SABL) and by the Lake Saint-Pierre ZIP committee. Six invasive plants have been selected for monitoring: *Hydrocharis morsus-ranae*, *Myriophyllum spicatum*, *Butomus umbellatus*, *Lythrum salicaria*, *Phragmites australis* and *Phalaris arundinacea*.

Outlook

Environment Canada is currently developing an integrated environmental monitoring approach for the Great Lakes–St. Lawrence Basin. However, additional efforts are required to harmonize classifications of wetlands and plant communities, and to develop wetland indicators and monitoring activities for this large ecosystem.

The vast areas of diversified wetlands occurring in the Great Lakes–St. Lawrence Basin shelter hundreds of plant and animal species of tremendous ecological and societal importance. Large-scale conservation initiatives, increased public awareness and improved public policies to protect wetlands have contributed greatly to lowering the rate of wetlands lost over the past decades.

However, wetland areas continue to oscillate, expanding in some regions while declining in others. Some of these modifications are caused by fluctuating

Photo: Martin Jean, Environment Canada

water levels and illustrate well the dynamic nature of wetlands, other changes can be considered as more permanent, revealing the vulnerability of these environments. However, the sustained degradation of wetland quality due to human activities and the progression of invasive exotic plants are leading to a growing sense of unease. Major multipartner monitoring initiatives are extending beyond political boundaries and creating basin-wide wetland monitoring standards. Cooperation between wetland monitoring programs in the Great Lakes and the St. Lawrence River will improve future communication of information throughout the basin.

The issue of exotic plant invasions for the St. Lawrence may differ from what is observed elsewhere. *Lythrum salicaria* (Purple Loosestrife), for example, is considered a serious problem in northeastern North America. Findings for the St. Lawrence, though, agree with some recent scientific studies that downplay the species's impact on wetland flora. However, the advances made by P. *australis* and P. *arundinacea* coupled with the rising number of exotic plant species poised to invade the St. Lawrence are disquieting. Heightened vigilance, particularly by local community members, and reinforced control methods will limit the number of invaders that come ashore to stay.

Scientists hope to maximize the use of modern technologies like high-resolution remote sensing satellites to collect data on wetland environments, thereby opening the door to a more detailed analysis of plant communities. Additionally, regular fieldwork will add to the precision of observed changes in wetlands, while allowing trends in invasive species to be monitored. Field data on wetland vegetation shows how dynamic these habitats are, both in terms of surface area and species composition. Land use by humans and fluctuating water levels, whether induced by natural hydrological cycles, climate change or other phenomena, are two of the most important factors affecting wetland dynamics.

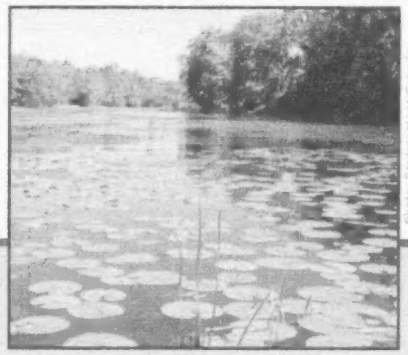


Photo: Environment Canada

KEY VARIABLES

Areal extent of wetlands

The regular production of wetland maps will allow us to estimate the surface areas of wetland classes and plant communities. By comparing these maps and analysing field surveys in detail, scientists should have some indication of trends in the surface areas of natural habitats and the distribution of the main plant species, including invasive ones.

Photo: Martin Jean, Environment Canada

To Know More

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State of the St. Lawrence Monitoring Program

Six government partners — Environment Canada, Fisheries and Oceans Canada, the Canadian Space Agency, Parks Canada Agency, the Ministère du Développement durable, de l'Environnement et des Parcs du Québec, the Ministère des Ressources naturelles et de la Faune du Québec — and Stratégies Saint-Laurent, a nongovernmental organization that works actively with riverside communities, are pooling their expertise and efforts to provide Canadians with information on the state of the St. Lawrence and long-term trends affecting it.

To this end, environmental indicators have been developed on the basis of data collected as part of each organization's ongoing environmental monitoring activities. These activities cover the main components of the environment, namely water, sediments, biological resources, uses and shorelines.

For more information on the State of the St. Lawrence Monitoring Program, please visit our Web site at **<www.planstlaurent.qc.ca>** or contact our offices at the following address:

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